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**Paper title:** The spatial profile of rail trips within the Sydney CBD

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**Abstract (200 words):**

A survey of rail passengers was undertaken to develop a spatial passenger profile of Sydney CBD. A self-completion on-train questionnaire and an 'interviewer led' platform survey were undertaken. The self-completion survey provided an 'unbiased' estimate of CBD station choice but suffered from imprecise destinations. The platform survey was more cost effective and provided accurate destinations but was difficult to 'factor'. Combining the two surveys produced an accurate, unbiased and cost effective profile. Estimated walk time catchments were compared with actual catchments. 77% of passengers used the CBD station that minimized walking time. However rail service level factors such as transfer, ability to get a seat and on-train time caused distortions that increased overall walk times by two minutes on average. Attitudinal questions established nine out of ten passengers used the same station in the AM as in the PM. 75% of those who changed station did so for transport reasons. Three-quarters chose their CBD station to minimise walking time. Differences in rail service level concentrated demand on Town Hall station which has the highest level of train service and most central location. Town Hall is also the busiest station. Station crowding was not an important factor in station choice however.

## 2 The spatial profile of rail trips within Sydney CBD

### Introduction to the network<sup>1</sup>

The Sydney passenger rail network is heavily focused on the Sydney CBD. Around 60% of all rail journeys in the AM peak (0600-0930) involve a trip that travels into or passes through the CBD as illustrated in Table 1.

**Table 1: CityRail Peak Patronage 0600-0930**

	Rail Journeys	Percent of Total Entries
Station Exits in Sydney CBD	141,600	46%
Through CBD Rail Trips <sup>1</sup>	50,000	16%
Total Travel into/through CBD	190,000	61%
Total CityRail Station Entries	310,000	100%

<sup>1</sup> Pass through but do not exit at a CBD station

Source: State Rail Authority (2003).

The CBD study area is shown as the green shade area overlaid over a schematic map of the rail network in Figure 1. Rail services either approach from the North (over the Harbour Bridge) or from the South via (i) Redfern then Central or (ii) Green Square then Central (Airport Line).



Source: RailCorp, NSW

**Figure 1: CityRail Network Map and CBD Station Study Area**

For study purposes, the Sydney CBD included the catchment areas of Circular Quay, Wynyard, Town Hall, Martin Place, St James, Museum, Central and Redfern stations.<sup>2</sup> In total 141,600 passengers exit through CBD station barriers during the AM peak period (0600-0930) and 140,300 enter during the PM peak period (1500-1830). CBD station usage is

<sup>1</sup> The views expressed represent the views of the authors and do not necessarily reflect the views of RailCorp.

<sup>2</sup> A set of “buffer” zones were created for peripheral areas where bus, ferry, car or taxi was used to access the CBD rail stations.

concentrated on Town Hall, Wynyard and Central stations which together account for three quarters of station barrier usage. Table 2 provides a breakdown of CBD station use for 2003.

**Table 2: CityRail Peak Patronage by Station**  
Weekday AM Peak (0600-0930) Barrier Exits and PM Peak (1500-1830) Barrier Entries

	AM Peak		PM Peak	
	Exits	Percent	Entries	Percent
Circular Quay	6,800	5%	8,800	6%
Martin Place	12,800	9%	10,400	7%
Wynyard	33,300	24%	30,000	21%
Town Hall	36,000	25%	36,600	26%
St James	5,100	4%	5,100	4%
Museum	5,600	4%	5,700	4%
Central	33,200	23%	35,000	25%
Redfern	8,800	6%	8,700	6%
<b>Total</b>	<b>141,600</b>	<b>100%</b>	<b>140,300</b>	<b>100%</b>

PM Peak percentages due not sum to 100% due to rounding.

Source: State Rail Authority (2003)

Table 2 suggests some redistribution of patronage to lesser utilised CBD stations particularly in the PM (when platforms become crowded with passengers waiting for trains) may mitigate current and projected station capacity constraints in the future.

### Study purpose

The future ability of CBD track and station capacity to meet continuing long term patronage increase safely and reliably has been identified as a key strategic planning issue (Office of Coordinator General of Rail, 2001).

Long term strategic rail demand forecasting in Sydney has been undertaken using the Sydney Strategic Travel Model (Kilsby and Milthorpe, 2002) which suggested that the Sydney Rail system is unlikely to be able to accommodate forecast patronage growth for the year 2021 without additional rail capacity through the Sydney CBD.

In assessing future rail capacity improvements, the spatial and temporal distribution of demand within the CBD needs to be understood at a 'micro' level to evaluate the demand impacts of possible new alignments including both the future loading of trains and the level of crowding at existing stations. As a precursor to developing a demand model of the CBD, a large scale survey of 13,400 passengers was undertaken between October 2002 and September 2003 by RailCorp NSW. Two types of survey were used: a self-completion questionnaire undertaken 'onboard' trains and an 'interviewer led' questionnaire undertaken on station platforms. This paper compares the two survey methods in terms of (i) survey effort and (ii) accuracy and then outlines how the two surveys were combined to produce an overall profile.

The resultant spatial profile of Sydney CBD patronage from combining the survey data is then considered. A pure walk time based station catchment is presented based on a walk speed survey and 'desk top' calculation of distances. The measured times are then compared with the 'stated' walk times. The resultant minimum walk time catchment map is then compared with actual patronage catchment maps to assess how rail service level (such as the need to

#### 4 The spatial profile of rail trips within Sydney CBD

transfer and the direction trains travel through the CBD) distorts passenger choice of CBD station.

Passenger attitudes to choice of station are then explored. The platform survey asked regular work and education commuters whether they used the same station in the AM as the PM and the main reason for any change. Passengers were also asked to nominate the station they would have used if the current station had not been available and then asked why they preferred their first choice station to their nominated ‘second best station’.

The main findings of the study are then drawn together regarding the survey approach, resultant spatial profile and passenger attitudes to station choice. It should be stressed that the paper does not seek to evaluate solutions to the problem of rail congestion but present research on underlying behaviour and spatial factors that should ideally be incorporated into any detailed evaluation of potential solutions.

#### Survey approach

The main aim was to develop a spatial profile of CBD patronage that could be used in modelling both AM and PM CBD rail demand.

The inception stage of the study considered the relative merit of ‘onboard’ train self-completion questionnaires and ‘platform’ interviews undertaken by surveyors. The surveys were compared in terms of their ease of implementation (efficiency), accuracy and potential biases. Table 3 lists the main problems which were identified and the solutions which were developed.

**Table 3: Problems and Solutions with Survey Instruments**

Survey	Problem	Solution
Onboard	Imprecise CBD destinations given by passengers filling in the onboard survey	Assign probabilities to study zones using available information of station, street name and stated walk time
Onboard	Difficult to distribute onboard survey forms on heavily loaded sections	Undertake platform surveys at inner stations and use on-off counts to factor response.
Platform	Difficult to interview passengers alighting at CBD platforms in the AM Peak.	Undertake surveys of passengers as they wait on platforms in the PM peak and use the ‘mirror image’ for the AM after adjustment for changes in station used (AM v PM).
Platform	Platform survey response affected by a relatively constant interviewing rate but varying platform arrival and occupancy rates which bias inception rates in favour of less well used CBD stations, non-work trips and lower frequency services (more chance of being surveyed).	Use the onboard survey, on-off counts and platform use to factor the response.

A ‘composite’ approach was developed:

- undertake “onboard” train self-completion surveys in the AM peak on selected lines with on-off train counts to factor responses and supplement with platform surveys at ‘close in stations’ where onboard completion rates were lower;

- undertake platform surveys in the PM (asking a question on the AM station used to determine the AM CBD station) and use the onboard data where available to factor the response;
- use Intercity train survey data provided from a study of Light Rail options (Booz Allen and Hamilton, 2004); and
- combine all data to produce a spatial profile of AM peak CBD destinations.

The questionnaire and interviewing approaches were then ‘piloted’ and refined so that:

- questionnaire design and method of onboard surveying/counts was optimized;
- interview rate (interviews per hour) and response rate were maximized;
- CBD destination were recorded as accurately as possible; and
- the zone structure was clear and unambiguous for interviewers.

A total of 13,389 completed questionnaires were undertaken between October 2002 and May 2003. Over the eight month period, surveys were not conducted during school holidays or university holidays. Two thirds of the questionnaire response was provided by the Platform Survey (undertaken in the PM peak only), with a quarter provided by the Onboard Survey (AM peak). The remaining 9% was provided by the Intercity Survey (AM & PM peak).

**Table 4: Sample Sizes**

Survey	Period	Sample Size	Percent of Total
Onboard	AM Peak	3,281	25%
Platform	PM Peak	8,814	66%
Intercity	AM & PM Peaks	1,294	9%
Total	-	13,389	100%

The onboard survey involved a “self-completion” questionnaire distributed and collected by surveyors and passenger counts undertaken at each station (including non CBD stations) or passengers getting on or off (and onboard between stops). The onboard questionnaire was a one page (A4) sheet and collected information on:

- board, alight and transfer stations; access and egress modes;
- trip origin and destination and suburb of residence;
- access and egress time to the rail station; and.
- car availability, ticket details, journey purpose; age, sex and occupation.

The platform survey was undertaken during the PM peak and involved face to face interviews of passengers waiting on CBD station platforms. The platform survey obtained information on:

- where passengers had travelled from – the CBD travel “zone”;
- transfer station or access mode to the station where interviewed;
- how long it had taken to “access” their first rail station;
- AM and PM stations used and reasons for any difference;
- second best CBD station and reasons for current station preference; and
- profile information - journey purpose, sex and age.

## 6 The spatial profile of rail trips within Sydney CBD

Intercity trains travelling to and from Central terminal were surveyed as part of the Central Sydney Light Rail Patronage study commissioned by the Department of Planning and Natural Resources (DIPNR) and undertaken by Booz Allen & Hamilton and Douglas Economics. The questionnaire was similar to the platform survey but was undertaken onboard Intercity trains which terminate at Central.

In terms of survey resources, the onboard survey cost just over twice the cost per interview than the platform survey to collect and process as illustrated in the cost index in Table 5.

**Table 5: Relative Survey Efficiency of Onboard Train and Platform Surveys**

Resource	Onboard	Platform
Fieldworker Time - Completed Questionnaires per Surveyor hour <sup>1,2,3</sup>	21	22
Data Entry Time – Questionnaires punched per hour	25	80
Coding of CBD Destination Questionnaires per Hour (sorted data)	20	-
Cost Index – Cost Index per Completed, Processed Interview <sup>4</sup>	1.15	0.55

<sup>1</sup> Includes re-positioning time for on-board train surveys. This is the time taken to catch a train away from the City back to a point where further surveys could be undertaken.

<sup>2</sup> Excludes cost of second surveyor (used to do on-off counts to factor response).

<sup>3</sup> Includes inner station platform surveys undertaken to supplement on-board train survey.

<sup>4</sup> Data entry charged at 75% the rate of interviewing (costs exclude set-up, management and analysis)

The main advantage of the platform survey was reduced data entry. The CBD destination zone (together with other response data) was coded ‘there and then’ by the interviewer onto record data sheets that allowed for 20 interviews. The completed sheets were then entered onto an EXCEL spreadsheet at a rate of 80 responses per hour.

The onboard questionnaire required a two stage data entry process. In the first stage, all the data fields including the full destination CBD address were typed in ‘verbatim’ at a rate of 25 questionnaires per hour. In the second stage, the records were sorted by street and station and the CBD destination zone then determined by reference to maps at an average rate of 20 responses per hour. The combined data entry rate was therefore 11 questionnaires per hour (only 9% of the platform survey rate).

The factoring process to expand the questionnaire response up to the total number of trips exiting CBD station barriers over the 3½ peak was complicated and involved eight steps. The process is set out in Figure 2.

Different expansion processes were used for the different surveys. For the onboard survey, ‘on and off’ train counts (undertaken for school children and adults separately) provided ‘control totals’ to balance the survey records. The iterative factors corrected for the tendency for longer distance trips to be over sampled and shorter distance trips (mainly passengers getting on closer to the CBD) to be under-sampled.

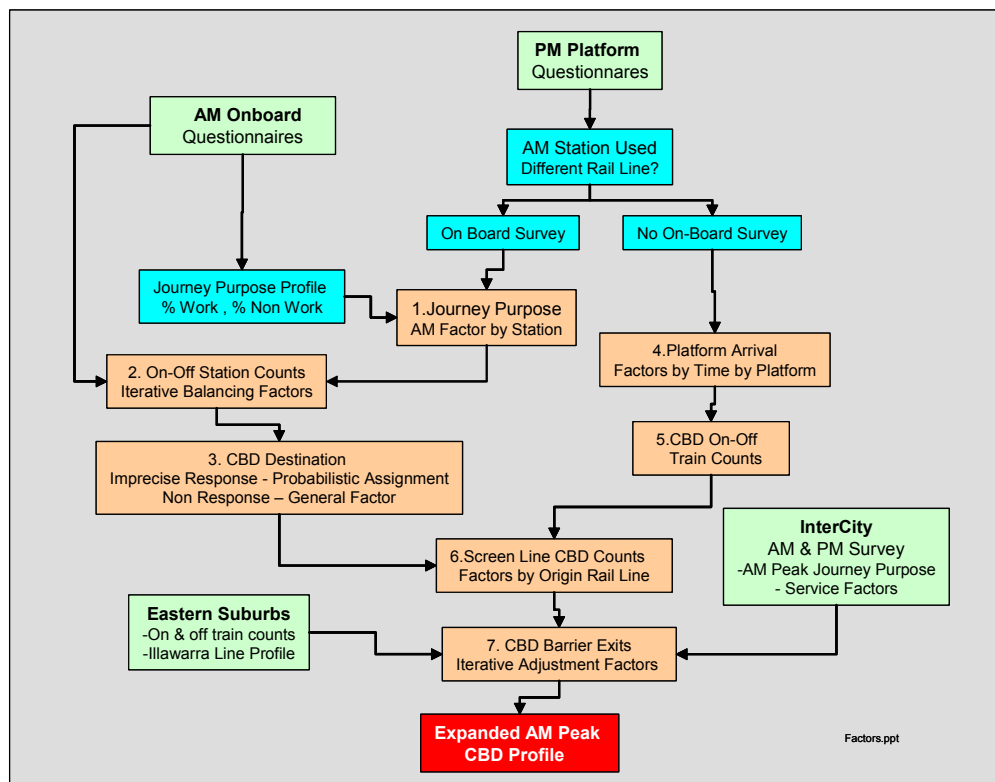
For the platform survey, the onboard survey counts provided the control totals to control for CBD station use (as well as Non CBD station use) and the journey purpose profile which was used to factor the platform survey to reflect AM use (rather than PM use which had a lower ‘commuting to work’ share).

For platform questionnaires that had no on-board survey counterpart (e.g. surveys of platforms serving the Western Line and Northern Line ), platform arrival rates (estimated from barrier counts and a platform occupancy survey) and a sample of ‘on-off’ counts of trains travelling through the CBD were used to factor the survey records.

The main weakness of the on-board survey was imprecise or no CBD destination details given by some respondents which made it difficult or impossible to allocate the questionnaire to a CBD zone. However, using the information provided it was possible to allocate 98% of responses.

Just over half the respondents provided information that was precise enough to determine the exact CBD zone. A further 43% provided sufficient information on the CBD station, walk time and street name to enable a “probabilistic zone” (covering up to six actual zones) to be determined<sup>3</sup>. 2% provided a walk time which enable the questionnaire to be assigned to either an inner, middle or outer catchment ‘band’ of zones around each station. The remaining 3% could not be assigned were not used in the spatial profile.

**Figure 2: Survey Expansion Process**



<sup>3</sup> Up to six zones could be coded. All zones had the same probability but by varying the number of zones, the probability changes. For instance, if the destination zone was one of four zones (A, B, C and D) and each zone was entered once, probabilities of 25% were assigned to each zone. By entering one zone twice (A), the probability of zone A increased to 40% with the probabilities for zones B, C and D declining to 20% each.



## 8 The spatial profile of rail trips within Sydney CBD

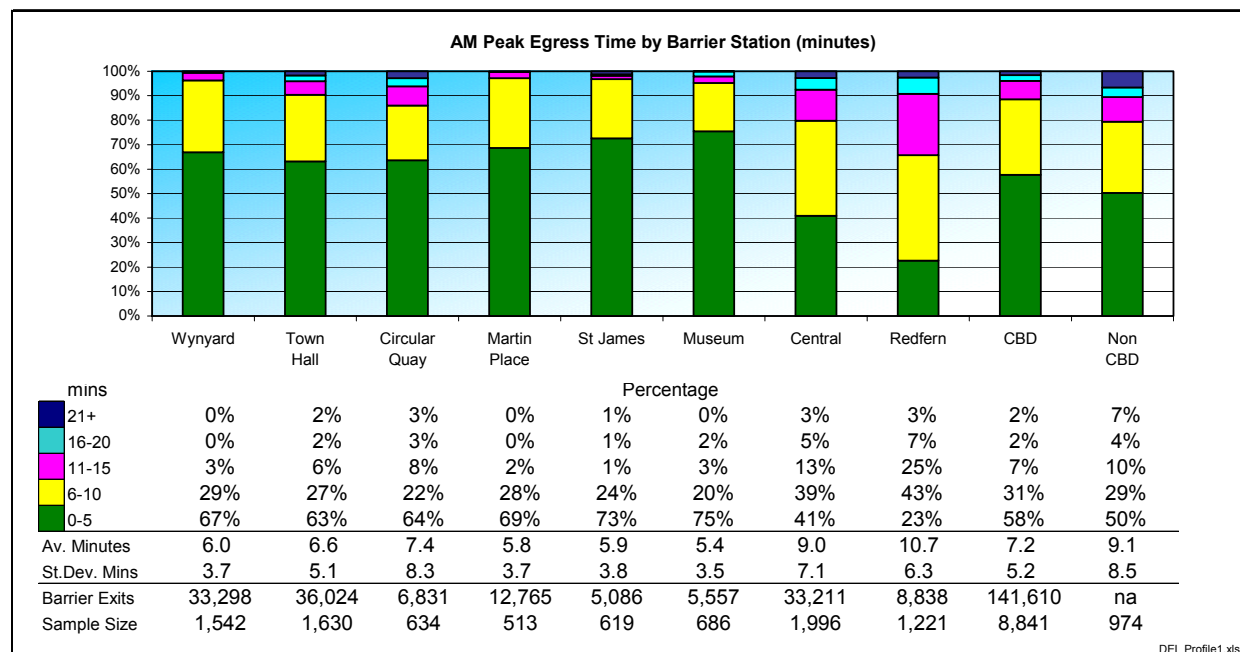
The last stage of the factoring process was to adjust the totals to 'screen line' volumes to match RailCorp loading checks and balance the barrier exit totals over all origin rail lines (including Intercity and Eastern Suburbs Railway estimates) to CBD barrier exit totals.<sup>4</sup>

### Walk time catchments

Walk dominated station egress with bus only used to travel from CBD rail stations to external zones such as the University of NSW (an external zone approximately 7km from the CBD). CBD egress times therefore reflected walking speed and distance from the station.

A pure walk time based station catchments was based on a 'measurement survey' of walk speeds and 'desk top' calculation of distances. The times were then compared with the walk times stated by respondents to estimate 'adjustment' factors to apply to the measured times for each station.

The average walking speed in Sydney CBD including junction delays was estimated at 5.6 kilometres per hour. There was no significant difference in east - west versus north - south walk times. The speeds, in conjunction with distances (estimated from maps), were then used to calculate walk times for each station - zone pair. The walk times 'stated' by respondents to the questionnaire survey were then compared with the 'measured' walk time estimates. The egress time profile for passengers to get to the CBD destination is presented in Figure 3.



**Figure 3: Stated egress time by station**

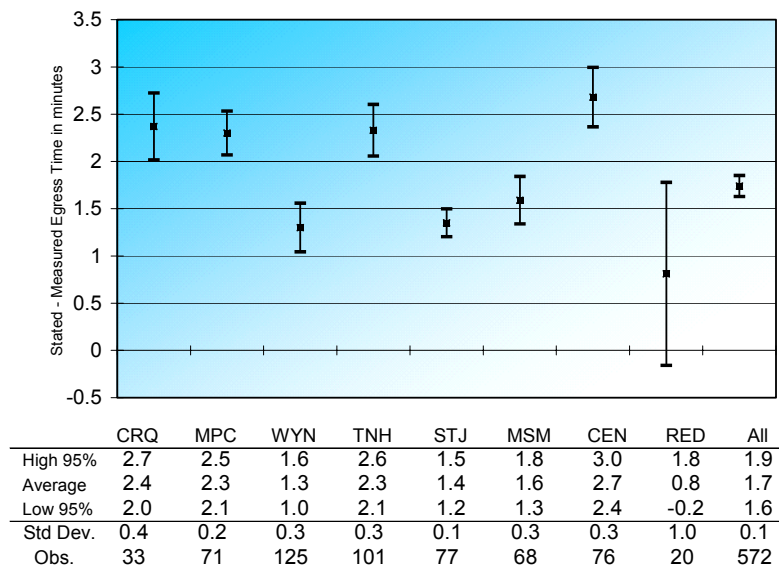
<sup>4</sup> The factoring process was 'iterative' which successively balanced the survey estimates with totals of CBD station barrier exit and 'screen line' rail passenger loads.



Egress times averaged 7.2 minutes and tended to be shorter for the central CBD stations than for Central and Redfern. Central CBD egress times ranged from 5.4 minutes for Museum to 7.4 minutes at Circular Quay. The longer egress times at Central and Redfern reflecting larger catchment areas and greater use of bus. Central egress times averaged 9 minutes and Redfern averaged 11 minutes. These two stations were also the only stations where over 20% of passengers had an egress time over ten minutes. Figure 3 also presents the egress time for passengers travelling to Non-CBD stations which averaged nine minutes (two minutes longer than at CBD stations).

For walk times of ten minutes or less, stated egress walk times were 1¼ minutes longer than the ‘measured’ walk times, Figure 4. Passengers may have “rounded up” their time to the nearest five or ten minutes or included the time from the platform to the barrier (whereas the measured times did not). Alternatively, the measured times may have been underestimated by the choice of zone “centroid” and/or barrier exit (the points ‘station to zone’ times were measured). There was no significant difference however for egress walks of over ten minutes however.

The difference in stated and measured times varied by station. For Circular Quay, Martin Place, Town Hall and Central, the difference exceeded two minutes. For Wynyard, St James and Museum, the difference was under 1.5 minutes whilst for Redfern (which has longer egress times to Sydney University) the difference was under a minute. The measured times for each station were adjusted to take account of the stated time discrepancy and used to calculate walk time from each of the eight CBD stations to each zone. Zones were then allocated to stations based on the minimum walk time.



**Figure 4: Stated v measured walks [stated walk times up to 10 minutes]**

The resultant ‘walk time’ station catchment map is presented in Map 1 (provided at the end of the paper)<sup>5</sup>. Alongside the walk time catchment map is the ‘overall’ catchment map (Map 2) which was based on the factored survey response for all trips exiting CBD station barriers in

<sup>5</sup> The maps were prepared by Andrew Kervill and Anthony Edenhofner of KBR Sydney.

the AM Peak 3½ hour period. Pie diagrams showing the percentage using each station are shown over shaded zones (the shading indicating the total number of trips to each zone). Town Hall's catchment was estimated to be much larger than its walk based catchment. Wynyard was estimated to be dominant in the north east restricting Circular Quay and Martin Place. St James failed to capture half the patronage of any zone on the eastern extremity of the CBD whilst Museum was limited to an eastern narrow band.

The actual station assignment of trips to stations is compared with the minimum walk time assignment in Table 6.

**Table 6: Actual versus Minimum Walk Time Station Assignment**

AM Peak Trips to Sydney CBD Study Area

	Trips	Percent of Total Trips	Total Walk Minutes	Av. Walk Minutes	Increase on Minimum Walk Minutes	Percent
Assigned to 'Minimum Walk Time'	102,679	77%	691,333	5.2	2.0	39%
AM Peak Trips to Study Area	133,441	100%	961,235	7.2	-	-

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77% of passengers used the station that minimised their walking time with 23% using a station that was calculated to increase walking time. Average walk times were estimated to be increased by two minutes from 5.2 minutes based on 'minimum walk' times to 7.2 minutes based on actual stations used (an increase of 40%).

Maps 3 and 4 compare the CBD catchments for patronage originating on two different lines—the North Shore and Illawarra. The two maps highlight the different catchments of stations serving passengers from different rail lines. This is to be expected as customers using Illawarra services can directly exit an Illawarra train at Martin Place but must interchange to a different rail service to exit at Wynyard whereas the reverse is true for the North Shore. Thus the maps show the importance of establishing separate catchments for each line.

### Substitutability of CBD Stations

The PM platform survey asked 'regular' rail passengers (defined as commuting to/from work or education) whether they had used a different station in the morning to the station they were interviewed at. Table 7 illustrates that 7% of CBD passengers used a different station in the PM. The percentage was over twice as high at Museum (19%) and St James (15%) reflecting the ability to walk across the CBD to use Town Hall or Wynyard to board / alight trains sooner.

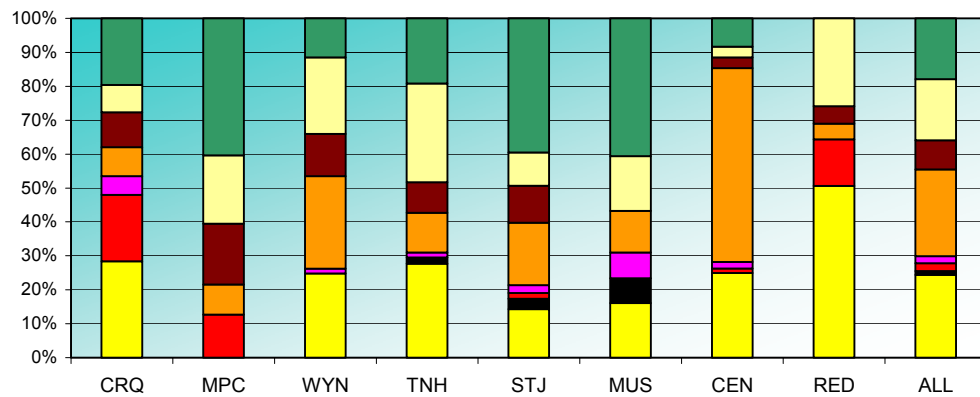
**Table 7: AM versus PM CBD Station for Regular Passengers**

Percent of Regular Passengers (Work or Education trips) who use a different CBD station in the AM to PM

Station	Wynyard	Town Hall	Circular Quay	Martin Place	St James	Museum	Central	Redfern	CBD
Percent	5%	8%	8%	8%	14%	19%	7%	4%	7%
Line	North Shore	Banks- town	East Hills	Illa- Warra	South & Inner- West	Western and Northern	Intra- CBD	-	CBD
Percent	3%	13%	12%	6%	8%	10%	8%	-	7%

Respondents were asked to give the main reason why changed station. Figure 5 gives the main reasons stated by respondents by PM station.

Reason	CRQ	MPC	WYN	TNH	STJ	MUS	CEN	RED	ALL
Shorter Walk	20%	40%	11%	19%	40%	41%	8%	0%	18%
Get a Seat	8%	20%	23%	29%	10%	16%	3%	26%	18%
Transfer	10%	18%	13%	9%	11%	0%	3%	5%	9%
Train Time/Timetable	8%	9%	27%	12%	18%	12%	57%	5%	26%
Station Facilities	6%	0%	1%	2%	2%	8%	2%	0%	2%
Less Crowded	20%	13%	0%	0%	2%	0%	1%	14%	2%
No Rail Tunnel / Safer	0%	0%	0%	2%	3%	7%	0%	0%	1%
Social/Exercise/Other	28%	0%	25%	28%	14%	16%	25%	51%	24%
Sample Size	26	16	92	62	80	26	57	21	380



**Figure 5: Reason for change to PM station (from AM station)**

Transport reasons explained three quarters of response. A shorter onboard train time / better timetable was given by 26% of respondents. 'Getting a seat' (18%), 'a shorter walk' (18%) and avoiding a transfer / improved transfer (9%) were given as primary factors. One quarter of respondents gave a 'non transport' reason such as meeting someone (10%) or shopping / entertainment (6%).

Reduced station crowding was only a significant for passengers switching to Circular Quay (20%), Martin Place (13%) and Redfern (14%). Most Circular Quay and Martin Place users switched from Wynyard (which experiences crowding on two of its four platforms). By contrast, few passengers switched from Town Hall because of crowding.

The platform survey also asked respondents which station they would use if their current station had been unavailable. Table 8 presents the response by interview station (denoted First Choice).

**Table 8: Second Best CBD Station**

Weighted Response for station pairs with sample size for CBD rail respondents only

First Choice Station	Nominated 'Second Best' Station								
	CRQ	MPC	WYN	TNH	STJ	MUS	CEN	RED	Non CBD
Circular Quay	-	5%	89%	2%	3%	-	2%	-	-
Martin Place	3%	-	30%	57%	10%	-	-	-	-
Wynyard	23%	6%	-	64%	2%	-	4%	-	-
Town Hall	-	6%	35%	-	9%	12%	37%	-	1%
St James	5%	14%	10%	56%	-	13%	2%	-	1%
Museum	-	-	-	56%	20%	-	23%	-	-
Central	2%	-	4%	65%	1%	10%	-	18%	1%
Redfern	-	-	-	1%	-	-	99%	1%	1%
All <sup>1</sup>	4%	3%	18%	41%	4%	5%	20%	4%	1%

<sup>1</sup> weighted in accordance with AM 3½ barrier exits by CBD station  
note row percent may not sum to 100% due to rounding

Town Hall was the clear second best choice. 41% of respondents (response weighted in accordance with CBD barrier exits) chose Town Hall<sup>6</sup> with Wynyard and Central half as popular again. The smaller five stations accounted for 21% with each attracting about 4%<sup>7</sup>. Thus the second best choice profile was broadly similar to the first choice profile.

Generally, the next closest station was selected subject to a direct service being available. Respondents were also asked for the main reason why they preferred their current station over their “second best station”.

The reasons for not using the second best station are presented in Figure 6. A ‘shorter walk’ was given by 71% of passengers (which is in broad agreement with the 77% calculated to have chosen the shortest walk time station).

Avoiding a transfer or obtaining a better transfer and ‘a shorter time on train / better timetable’ were second equal with 8%-9% each. Getting a seat was fourth with 4%. Non transport reasons such as ‘meeting someone’ were given by 5% of respondents.

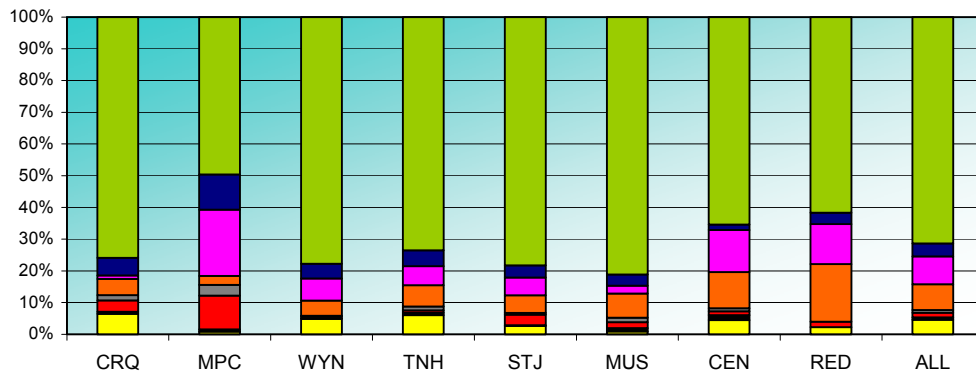
Station crowding (2%) was not a primary factor overall with “less crowding” only mentioned at Martin Place (11%) and Circular Quay (4%).

Central and Redfern tended to have similar profiles with ‘avoiding a transfer’ (13%), ‘getting a seat’ and train time / timetable accounting for 18% at Redfern and 11% at Central.

<sup>6</sup> Intercity passengers were not asked the ‘second best CBD station’ question.

<sup>7</sup> A few respondents chose Non-CBD stations (mainly Kings Cross).

Reason	CRQ	MPC	WYN	TNH	STJ	MUS	CEN	RED	ALL
Shorter Walk	76%	50%	78%	74%	78%	81%	65%	62%	71%
Get a Seat	6%	11%	5%	5%	4%	3%	2%	4%	4%
Transfer	1%	21%	7%	6%	6%	2%	13%	13%	9%
Train Time/Timetable	5%	3%	5%	7%	6%	8%	11%	18%	8%
Station Facilities	2%	3%	0%	1%	1%	1%	1%	0%	1%
Less Crowded	4%	11%	1%	1%	3%	2%	1%	2%	2%
No Rail Tunnel / Safer	1%	1%	0%	1%	0%	1%	2%	0%	1%
Social/Exercise/Other	6%	1%	5%	6%	3%	1%	5%	2%	5%



**Figure 6: Main reason for preferring station [Main reason given for using station over nominated second best station]**

At Central, avoiding a transfer or a better transfer (13%) and train time/timetable (11%) were more important with a 'shorter walk' accounting for 65% of responses. At Redfern, 18% of respondents gave a shorter train time / better timetable as the primary reason. The highest percentage giving 'a shorter walk' was at Museum at 81%. At Town Hall, 74% gave 'a shorter walk' with the next most important reason being time / timetable with 7%.

## Concluding Remarks

Surveys were undertaken to develop a spatial profile of rail customer behaviour. It was found that a composite approach using an AM peak onboard train questionnaire with on-off counts combined with a PM station platform survey produced the most accurate, least biased and most cost effective approach. An expansion method was used that assigned destination response on a probability basis to zones whilst balancing aggregate response to CBD station barrier counts and inbound train passenger loadings.

Minimum walk catchments were compared against observed catchments to assess the importance of walk time versus rail service level. Three-quarters of passengers used the CBD station that minimized their walk time. Avoiding a transfer and a more convenient timetable were next two most important transport reasons. For the CBD as a whole, it was calculated that average walk times were increased by two minutes from 5.2 minutes based on 'minimum walk' times to 7.2 minutes based on observed station use.

Although ‘secondary’ in importance, non-walk time factors such as avoiding an interchange caused a significant expansion of Town Hall’s station catchment area. The resultant aggregate popularity of Town Hall causes significant platform congestion in the PM peak. The market research however did not establish crowding to be a significant ‘deterrent’ factor amongst passengers who choose not to use Town Hall.

The market research discussed in this paper will be used in a ‘micro’ CBD demand model to evaluate alternative rail operating plans including new alignments, station locations and demand management options. By assessing demand response, the model will enable alternative options to be assessed in terms of their ability to distribute patronage across CBD stations more efficiently and effectively.

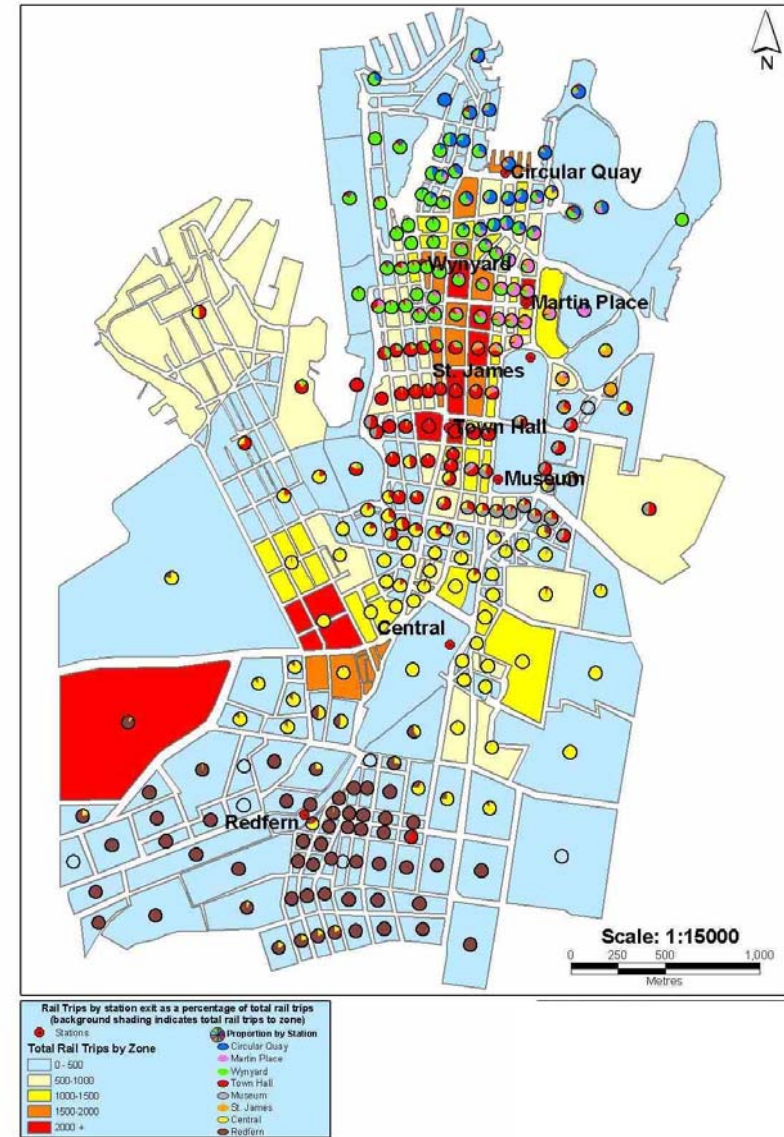
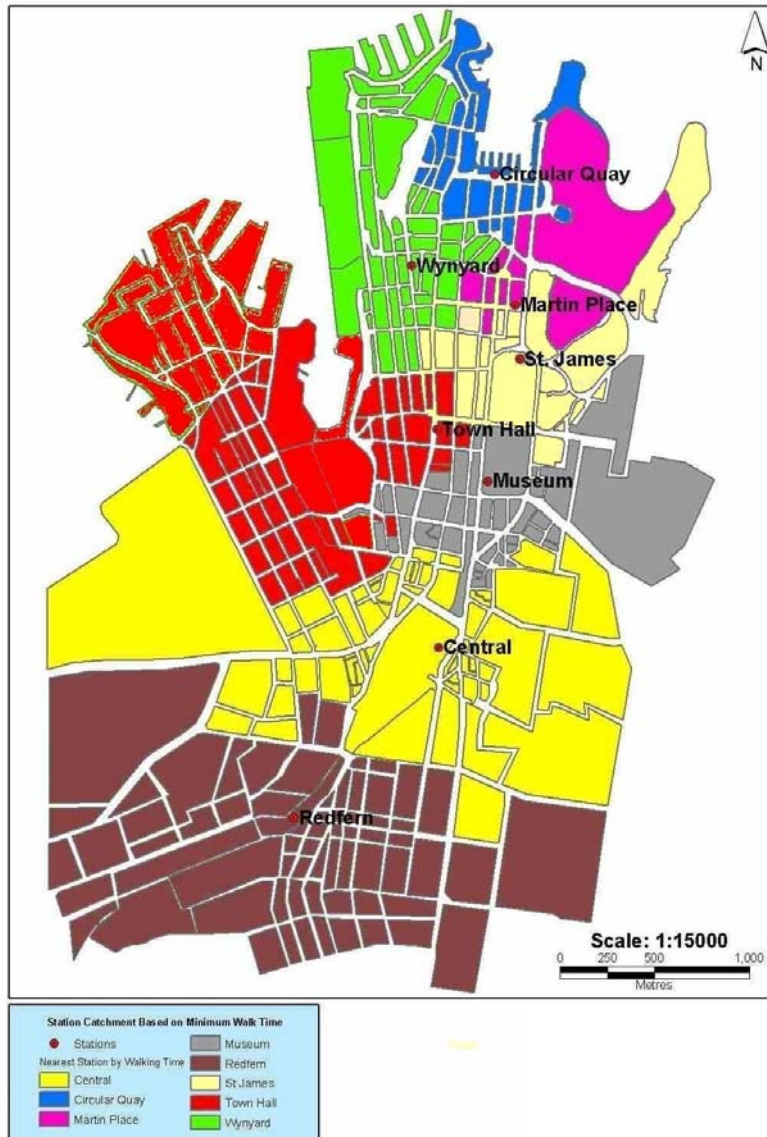
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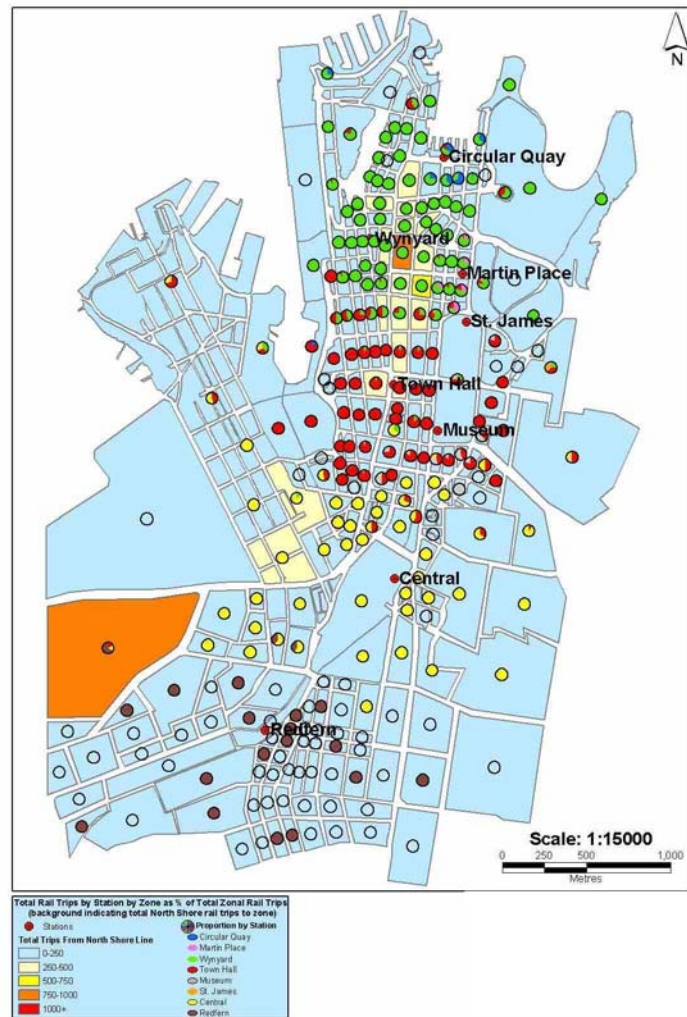
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**Map 3: CBD AM Peak Catchment – North Shore Line**



**Map 4: CBD AM Peak Catchment – Illawarra Line**

